

Dental implants maintenance: an observational study on 200 patients

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Aim

Aim of this study was to analyze the efficacy of oral hygiene procedures and devices in the prevention of peri-implant disease.

Materials and methods

The use of oral hygiene maneuvers and their typology were investigated in two hundred patients, with at least one implant placed. Data about frequency and duration of domiciliary dental care were collected together with risk factors and anamnestic data too. Plaque and bleeding indices were used to evaluate the oral status of the sample and, sequentially, a statistical analysis was performed.

Results

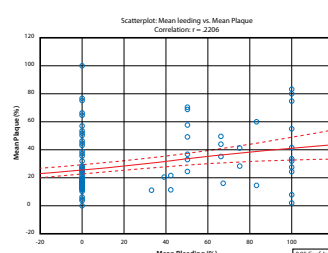
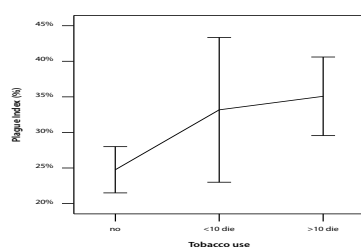
The results demonstrate that patients who used oral hygiene devices (interdental brush, dental floss) associated to toothbrush show lower plaque index values. The simultaneous use of different devices achieves better results than the use of a single one. No significant differences were noticed between the single use of each device.

Conclusion

The use of the oral hygiene devices analyzed and presented in this study, alone or in combination, could be recommended in order to prevent peri-implant disease.

Key words:

*Dental Implants,
Oral hygiene
devices,
Bleeding on
probing,
Plaque Index*



Introduction

The placement of osseointegrated implants is becoming one of the most predictable and efficient treatments in the rehabilitation of partially or fully edentulous patients. However, even if in the recent years an increase of both the implant survival and success rates was observed, the pathological conditions that may lead to implant loss should not be underestimated. Implant failure could occur early after surgery, due to unsuccessful osseointegration process, or later for biological or bio-mechanic reasons. Many authors demonstrated that the most frequent cause of implant loss is the onset of peri-implant disease, strictly related to the infection of peri-implant tissues (1, 2). Dental implants, in fact, are characterized by surfaces, often rough, that are potentially colonized by bacteria harbored in the oral cavity.

In order to determine the long-term success of the implant therapy, it is mandatory to identify the early signs of disease through the continuous clinical evaluation and maintenance of the patient, assessing the main risk factors and planning correct interventions validated by the most recent evidence-based medical literature.

Biological processes leading to implant failure may be slow and gradual. The use of appropriate periodontal parameters and index systems, in order to convert personal impressions into digital data, could help the clinician to control in detail the progression of diseases and compare the therapeutic algorithms stated by the international guidelines.

The parameters routinely used during maintenance therapy of patients treated with implants, should be enough sensitive and allow detection of early changes. Many clinical signs of failure, in fact, appear only when an advanced step of disease has already been reached (3). Routinely peri-implant evaluation and professional oral hygiene session program seem to be the most important procedures to prevent peri-implant disease. However, it is not possible to achieve good level of oral hygiene only performing professional hygiene. For this reason, patient motivation and home dental hygiene are parameters to focus on, even before planning the surgical step. Toothbrush and dental floss should be used according to oral hygiene instructions given by the clinician; however, considering the advanced average age of edentulous patients and the difficulty to learn or perform appropriate oral hygiene techniques, the use of interdental brush and dental floss is worth further consideration.

Aim of this research was to compare the efficacy of oral hygiene procedures and devices, by evaluating bleeding on probing and plaque index on dental implants (4-5).

Study population and methodology

Selection of the sample

In this study, 200 patients were evaluated. All the collected data remained anonymous. All patients were fully informed about the purpose of the study and informed consent was obtained. Data collection was carried out from November 2012 to December 2013.

Description of protocol

For each patient a medical history form was completed and Plaque index (PI) and Bleeding on Probing (BOP) were recorded in order to compare them with their oral hygiene habits, both at home and professional.

Modified Plaque Index

Plaque is considered as an important etiological factor in peri-implantitis development. It is therefore appropriate to assess oral hygiene through a quantitative method. The original PI has been slightly modified to assess plaque formation in the marginal area on ITI implants (mPI) (Table 1) (6). The plaque index was recorded in 4 sites only around implants by circumferential probing with a special plastic probe. The 4 dental sites considered were: buccal, mesiobuccal, distobuccal and lingual/palatal. The 4 measurements taken were summed and divided by 12 (maximum number given by the sum of the site's values of the highest PI score) in order to obtain the PI for the single element.

The PI for subject was then calculated as the average of the index of the individual implant site. (Mean: sum of the indices of the individual implant sites divided the number of sites considered).

Gingival Bleeding Index

This Gingival Bleeding Index, introduced by Ainamo and Bay (1975), is performed through a gentle probing of the orifice of the gingival crevice. If bleeding occurs within 10 seconds, a positive finding is recorded and the number of positive sites is recorded and then expressed as a percentage of the number of sites examined. Bleeding can also function as a motivating factor in spurring patients to improve their oral home care.

A total average percent of bleeding index for single patient was given: it takes into account the values of all dental implants (4).

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (version 21.0, SPSS Inc.,

Score 0	No detection of plaque.
Score 1	Plaque only recognized by running a probe across the smooth marginal surface of the implant.
Score 2	Plaque can be seen by the naked eye.
Score 3	Abundance of soft matter.

TABLE 1 Assessment of plaque accumulation by a modified Plaque Index (mPII).



Independent variables	Category	Total number	%	Plaque Index (%)	p-Value
Age (years)	<54	67	33.5	27.2±20.0	0.31
average 57	54-61	61	30.5	25.4±17.1	
range 23-83	>61	72	36.0	30.5±20.9	
Gender	M	84	42.0	28.9 ±19.6	0.52
	F	116	58.0	27.1 ±19.5	
Tobacco use	No	140	70.0	24.8±19.4	0.003
	<10	9	4.5	33.2±13.2	
	>10	51	25.5	35.2±19.1	
Professional oral hygiene (n° session/year)	0	22	11.0	31.5±18.2	0.36
	1	60	30.0	25.1±19.7	
	2	82	41.0	27.2±19.8	
	3	18	9.0	34.8±21.7	
	4	18	9.0	28.3±16.6	
Frequency of domiciliary dental care	1	9	4.5	45.2±20.4	0.01
	2	105	52.5	28.2±20.4	
	3	86	43.0	25.5±17.6	
Duration of domiciliary dental care (min.)	<1	37	18.5	33.8±21.9	0.04
	>1	163	81.5	26.5±18.8	
Oral hygiene devices (n°)	0	80	40.0	30.8±19.8	0.17
	1	90	45.0	26.5±19.9	
	2	30	30.0	23.9±17.0	
Type of oral hygiene devices	None	80	47.6	30.8±19.8	0.27
	Interdental Brush	49	29.2	27.3±18.0	
	Dental Floss	39	23.2	24.7±22.4	

TABLE 2 Descriptive statistics and analysis of variance (one- way ANOVA) of independent variables.

Chicago, Illinois, USA). Recorded data were used for calculations of mean values and standard deviations. One way ANOVA test was used to measure the association between each independent variable and the outcome variable (Plaque Index), followed by the post-hoc least significant difference (LSD) test for intergroup differences. The Pearson coefficient was used to measure correlations between the clinical measurements. P values less than 0.05 were considered to be statistically significant.

Results

200 patients (84 females, 116 males) aged 23 to 83 years (average age 57 years) were entered into this study. The descriptive statistics for the sample are summarized in Table 2.

Tobacco use

Significant differences in the amount of plaque were noted between the three groups of smokers ($p=0.003$). Post hoc analysis revealed a statistically significant difference between heavy smokers group (>10 cigarettes a day) compared to the no smokers group ($p=0.001$), but no statistically significant differences were observed between the other groups (Fig. 1).

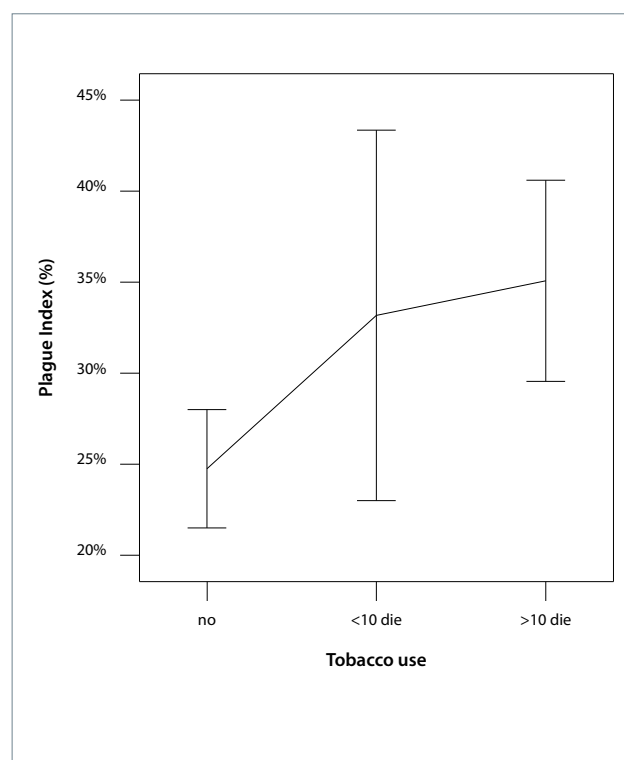


FIG. 1 Relationship between tobacco use versus PI.

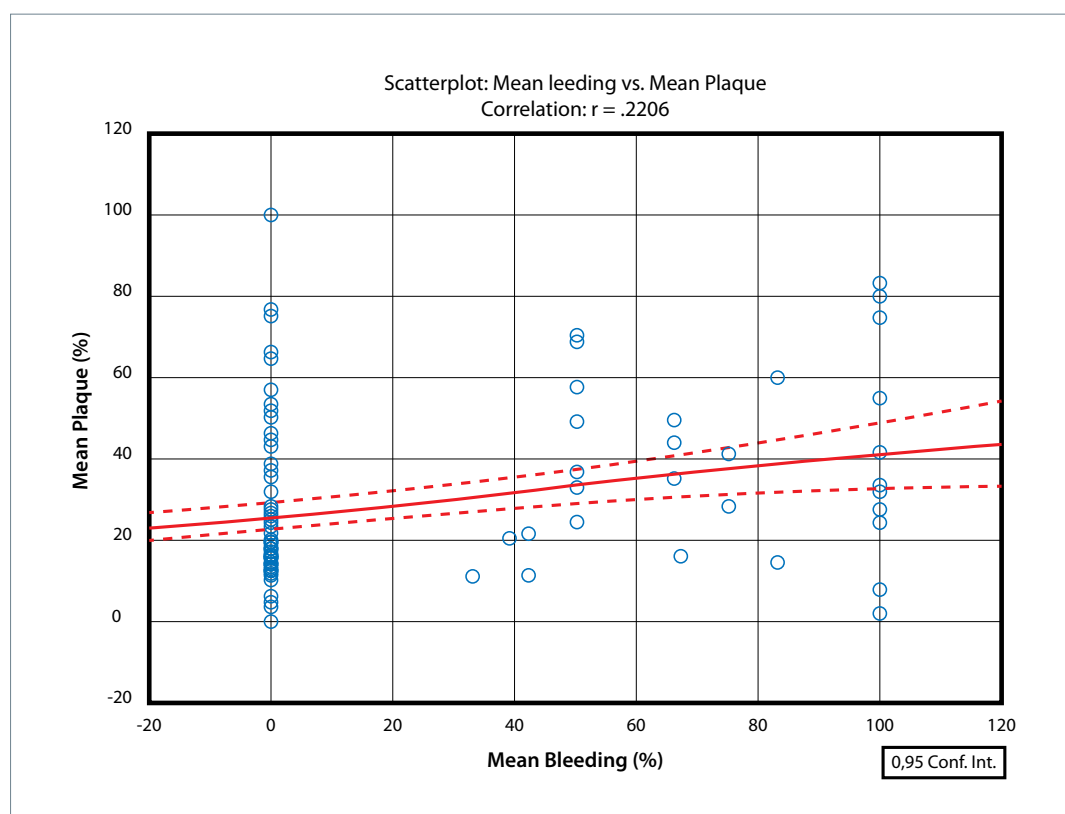


FIG. 2 Scatterplot representing the correlation between mean plaque and mean bleeding (Pearson's $r = 0.22$; $p = .002$).

Professional oral hygiene

From the sample of 200 patients, 22 patients had not undergone any professional oral hygiene session with a mean of PI around the implants of 31.5% (± 18.2), 60 patients underwent a single yearly session showing a PI of 25.1% (± 19.7), 82 patients a two yearly sessions with PI of 27.2% (± 19.8), 18 patients three sessions with PI of 34.8% (± 21.7), 18 patients four sessions with PI of 28.3% (± 16.6). No significant differences in the amount of PI were noted between the five groups.

Frequency of domiciliary dental care

As it is inferred from data, a reduction of 17% of PI between patients that perform domiciliary dental care once and twice daily has been found. This difference was statistically significant ($p=.01$).

Duration of domiciliary dental care

The analyzed sample was composed of 37 patients who performed sessions of domiciliary dental care in less than one minute and of 163 patients declaring to dedicate more than one minute to domiciliary dental care.

The percentage of PI in the first group resulted 33.8% ($\pm 21.9\%$), while the second group showed PI of 26.5% ($\pm 18.8\%$). This difference was statistically significant ($p=.04$).

Number of oral hygiene devices

80 patients did not use any oral hygiene devices presenting a PI of 30.8% (± 19.8), 90 used a single oral hygiene device presenting a PI value of 26.5% (± 19.9) and 30 patients used two oral hygiene devices showing a PI of 23.9% (± 17.0).

The differences between the three groups were not statistically significant.

Type of oral hygiene device

The comparison between the three groups showed no significant difference, even though dental floss showed the lowest PI values.

Finally, a significant correlation was found between PI and BoP ($p=.002$) (Fig. 2).

Discussion

The most frequent reason of implant failure could be attributed to peri-implant infections. Peri-implant infections are generally classified as peri-implant mucositis and peri-implantitis depending on the severity, reversibility and loss of supporting bone (1). The phlogosis of the soft tissues surrounding an implant is evidenced in both the pathologies. Periimplantitis, however, may not develop in all periimplant sites with mucositis, just as periodontitis may not develop in all sites with gingivitis (6). According to Fardal and Grytten, the cost of maintaining implants is much higher than the cost of maintaining teeth (7). Several studies proved a correlation between the bacterial flora observed in periodontal and peri-implant tissues (8, 9). Furthermore, mucositis and peri-implantitis were associated to the same bacteria that induce respectively gingivitis and periodontal disease, while the flora associated with healthy peri-implant tissue seems to be similar to the microbiota related with healthy gingiva (9).

An adequate plaque control performed by the patient is basic to avoid the onset of infections both in teeth and in dental implants (10, 11). In long term studies, patients with good oral hygiene tended to keep implants longer. With adequate oral hygiene practices, the presence of keratinized peri-implant mucosa appears not to be essential for the maintenance of

implant stability (1). The only successful option to prevent plaque formation is represented by the mechanical removing performed by different oral hygiene devices.

Many authors investigated the correct techniques and maintenance protocol for dental implants (12-15). Patients should be evaluated at regular intervals to monitor their peri-implant status, the condition of implant-supported prostheses, and plaque control. The key role of home oral hygiene is universally known. The evaluation of oral hygiene and patient motivation prior to the implant placement is indicated; imparting clear oral hygiene instructions and a good motivation is paramount (16). Clinicians should pay attention to communicate to the patient the importance of home care, and be sure to be completely understood. Home care instructions should be customized according to implant design and accessibility (17). Several oral hygiene devices were designed and produced for different dental areas and different patients. The interdental space is one of the most difficult areas to be cleaned, especially for elderly people. There are several devices designed to operate in an easy and efficient way: dental floss, single and interdental brushes.

Two of the most useful and indicative parameters to investigate peri-implant disease are BoP and PI. The present study focused attention on the evaluation of these two indices specifically on dental implants. In the present study a strict correlation between the presence of plaque and bleeding was found; in fact, plaque represents a reservoir of bacterial pathogens for focal infections, which activate a local inflammatory response. Nevertheless, Newcomb et al. demonstrated that it is not possible to relate a specific bacterial assay to clinical signs such as bleeding on probing or suppuration (18). The present study also investigated whether there was correlation between PI compared to the consumption of cigarettes. A statistically significant difference was detected only in the plaque index of heavy smokers. In a previous study performed by Bastiaan and Waite plaque levels appeared to be higher in smokers than nonsmokers, even though the differences were not statistically significant (19). No consistent differences were evident in the gingival status of the two groups, according to the present study. Smokers group showed a higher percentage of Gram + bacteria than nonsmokers in the first three days of evaluation. Muller et al. according to our results, examining 65 patients, recorded an increase of supragingival plaque and calculus in heavy smokers group, both at time 0 and 6 months, while comparing the single sites, lower values of BoP were observed (20). This figure is probably related to the reduction of vascularization due to the action of smoking.

At the beginning of implantology, the key for long-term success of osseointegrated implants was the surgical phase. In more recent years, clinicians recognized professional implant maintenance and diligent patient home care as two critical factors for the long-term success of dental implants (15). The adoption of a systematic hygienic protocol is effective in keeping low the incidence of peri-implant mucositis as well as in controlling plaque accumulation and clinical attachment loss (10).

As far as plaque and bleeding are concerned, this study inferred that professional hygiene does not significantly affect in terms of frequency and duration if compared to the importance of the accuracy of domiciliary dental care. Furthermore, even the study of Kracher et al. suggested that the negation of early microbial accumulation on the

dental implant surfaces and the elimination of at least 85% of plaque biofilm by the patient are crucial for a long-term success (21).

Another point addressed was to identify which of the oral hygiene aids to be associated with brushing, estimated on the strength of reduction of plaque and bleeding, would allow a better compliance of the patient with implant-prosthetic rehabilitation. In the studies found in the literature on natural teeth, it has been found that the use of dental floss associated with brushing would permit a reduction of bleeding of 50% aside from type of floss used (waxed, flat, spongy) (22)]. Also Ong et al., in a comparative study, did not observe statistically significant differences between three different kinds of dental floss (12). Over the years, it has been generally accepted that dental floss has a positive effect on removing plaque and decreasing bleeding (9-11). The American Dental Association (ADA) even reports that up to 80% of plaque may be removed by this method. Several reviews have been conducted on the effectiveness of different procedures and devices dedicated to interdental space, however, only few reviews are systematic and none of them has conducted a meta-analysis. Also, a limited number of papers provided data on the efficacy of flossing and tooth brushing compared to tooth brushing alone. Warren et al. demonstrated that flossing in association with tooth brushing produced no clear benefits (23). Additionally, a recent review showed that self-flossing has no effect on reducing caries risk (5). The present study did not evidence statistically significant differences between dental floss and interdental brush on dental implant, even though dental floss seemed to show lower PI values. Interdental brushes commercially available have different shapes and designs. Jordan et al. in a randomized controlled trial concluded that straight interdental brushes might better remove plaque interproximally when compared to angled interdental brushes (24). The recent literature highlighted also how the use of interdental brush seems to guarantee better performance expressed as lower PI and BoP values on natural teeth (25-27). De Slot et al., in a systematic review, analyzed the effects of the use of interdental brush associated to toothbrush (25). Not only they observed that interdental brush removes more dental plaque than brushing alone, but also that in most studies had a positive significant difference on PI when compared with dental floss. Christou et al. affirmed that the use of interdental brushes is more effective in plaque removal and results especially in a larger reduction of probing depth than the use of dental floss (27). Even observing small differences between the groups, according to patient preferences, they concluded that interdental brushes should be considered preferable to floss. The data of this study do not prove that an aid of oral hygiene was more effective than another; also the study of 2010 of Kracher et al. emphasized how domiciliary dental care is dictated by the prosthetic design (location and angulation of the implants, the length and the position of the transmucosal abutments) and that the choice of the most suitable device depends on the indications of each single patients (21).

Conclusion

According to the results of this study, it may be concluded



that interdental brush and dental floss, associated to toothbrush, remove more dental plaque than brushing alone. No significant differences were observed in the comparison between the various devices. The communication with the patient is still the most important valuable step: analyzing risk factors and underlining the importance of motivation. The clinician should choose on the basis of the prosthetic design and patient compliance.

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